

Steven Geer Notes from the NoVA WGM presentations, 20th February, 2007.

Preamble:

Mark Messier presented the case for a NoVA off-axis near detector located in the existing access tunnel to the MINOS near hall. If the near detector is to see the off-axis neutrino beam with the same orientation as the far detector, it must be rotated with respect to the tunnel axis. This requires some civil construction. John Cooper presented the various options for the tunnel modification. Based on the assumption that the civil construction will be funded by reducing the far detector mass, we were told that the NoVA Collaboration prefers the cheapest (just good enough) solution for the required tunnel modification.

Comments/Impressions:

- 1. The case for a rotated off-axis near detector.** I think the case is clear. In a long baseline neutrino experiment, systematic uncertainties on fluxes, cross sections, and detector efficiencies can be greatly reduced by having a near detector that uses the same detector technology as the far detector, and to a good approximation “sees” the same beam. We were shown that, to fully exploit the NoVA data sample, the collaboration wants to reduce the systematic uncertainties well below the 10% level, and preferably down to of order 5%. The NoVA studies indicate that an off-axis near detector is needed to reach these levels of systematic precision. If the near detector is aligned with the tunnel axis, and therefore misaligned with the off-axis beam, the cancellation of the systematics in the near-to-far detector comparison is degraded. Given this, I think there is a solid case for a NoVA off-axis near detector pointing in the right direction.
- 2. Is the proposed near detector adequate?** The NoVA studies presented suggest that, given the identified sources of systematic uncertainty and their expected levels, the proposed off-axis near detector is adequate to facilitate, in the far detector, a 3 sigma observation of ν_e appearance for $\sin^2 2\theta_{13}$ down to ~ 0.01 . However, if NoVA sees a signal corresponding to $\sin^2 2\theta_{13}$ much larger than 0.01 the focus of the experiment will shift to the determination of the mass hierarchy. This scenario was not discussed in the WGM, leaving us to wonder whether NoVA will eventually need a more ambitious near detector to further reduce systematic uncertainties. It is admittedly difficult to anticipate the balance between systematic and statistical uncertainties in every plausible scenario, and the proposed near detector does seem to be a sensible choice.
- 3. Considerations in choosing between the civil construction options.** If the civil construction really is to be funded at the expense of reducing the far detector mass, it is understandable that the NoVA Collaboration prefer the cheapest solution. I think that two additional considerations should be taken into account in selecting from the various tunnel modification options. First, since the neutrino program may be the only major accelerator-based program at Fermilab in the

decade beyond the Collider, it seems unwise to make a choice that unnecessarily constrains future experiments that might be proposed in the tunnel or near hall. Second, it would seem wise to give some consideration to the space that might be needed for plausible future upgrades to the near detector. For example, should NoVA eventually need to add a fine grained section at the front of the near detector, could this be done without further civil construction?